Contingent Valuation Method for General Practitioners: A Cookbook Approach

Bright Honu*

Abstract

Contingent Valuation Method (CVM) has become an increasingly attractive method for the valuation of non-market goods and services, such as preservation of bio-diversity of habitats, and for assessing the demand for sanitation services and improvements in water supply. The technique has shortcomings some of which are inherent, particularly in situations where most of the benefits of the good being valued does not derive from its use. Other shortcomings arise mainly in the application of the technique in developing countries where, for example, because of inadequate information on households a sample used for the CVM may not be truly representative. Once these shortcomings are noted and steps are taken to minimise their impact, CVM surveys provide valuable information of use to policy makers. This paper provides readers with little or no training in non-market valuation techniques with a practical guide to such techniques.

1. Introduction

There has been an increasing need for economists and policy makers to put monetary value on non-market goods and services such as environmental assets and ecosystems. Whilst a few years ago, the impact of a project on these goods would at best be described in a footnote, the current trend is to take explicit account of them in economic analysis. This shift is due to the general acceptance of the social importance of these goods, and the implications of not properly accounting for them in economic evaluation. After all, the essence of economic analysis is to compare all benefits with all costs (appropriately discounted if necessary). Without valuing non-market commodities it is not possible to compare different projects on equal basis as individual projects differ in their impact on these non-market goods. As a result a policy that is based on analysis which excludes the value of non-market goods may not be socially optimal.

Non-market goods and services such as clean air differ from regular goods and services such as red wine or hair-cut mainly because as the name implies, non-market goods and services are not bought and sold in a market hence there are no market prices for these goods. However, as argued in Krutila (1967), these goods provide utility or enjoyment to both people who use them (use values), and people who do not use them (non-use or passive values) and ought to be included in benefits. For example, a person who may never go to *Molimo Nthuse Nature Reserve* may yet derive welfare from

* Bright Honu is a Senior Lecturer in the Department of Economics at the National University of Lesotho.

the mere fact that the park is there for future generations to enjoy. Even though there are many methods for valuing non-market goods, contingent valuation method (CVM) is one of the most widely used survey-based methods of valuing non-market goods because it is the only method capable of measuring non-use value. See Figure 1 for a breakdown of total economic value. Figure 1 has intrinsic value as part of total value, however economists concern themselves with economic values only.

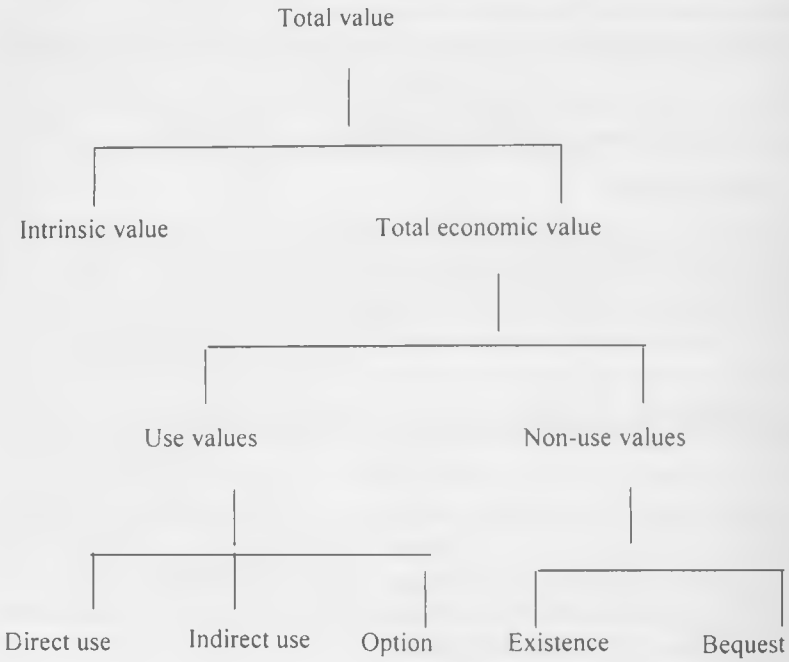

Figure 1: Illustration of total economic value of a non-market

It is important to note that it is best to interpret the different values in Figure 1 as the various reasons why people value non-market goods. Consequently it would not make sense to attempt to estimate empirically only one component of economic value (Carson et al 1999). CVM can also be used to measure the willingness to accept compensation for putting up with a fall in quality of, say, an environmental asset.

This paper has two target audiences in mind namely: the policy maker or non-economist who is interested in having a working knowledge of CVM even though he or she may never carry out a CVM study. This paper may, at least, help such a person to understand how CVM estimates are arrived at. The second target audience is the student or researcher who has not taken any courses in valuation techniques but whose dissertation or report requires the valuation of some non-market commodity. The number of such students or researchers is increasing given the growing importance of non-market goods in economic or planning policies. Such a student or researcher, regardless of whether he or she has done economics can, with the help of this paper, be able to undertake such valuation.

We continue by providing a brief discussion of the techniques of valuing non-market goods and services in Section 2, followed by a discussion of the process of carrying out a contingent valuation in Section 3. Section 4 provides an illustrative example of estimating WTP. Section 5 discusses some issues relating to the CVM in general and developing countries in particular. Concluding comments follow in section 6.

2. Methods for valuing non-market goods

Various techniques have been developed by economists for the valuation of non-market goods. These techniques fall into two broad groups: namely revealed preference and stated preference techniques or methods. Both methods require surveys. These surveys can be postal, telephone, self-administered or face-to-face interviews, with each having advantages and disadvantages. However, in developing countries face-to-face surveys are considered the most appropriate because of the low literacy rates and the poor postal and telephone infrastructure generally found in these countries (Turner et al. 2004).

2.1 Revealed preference techniques

Under revealed preference techniques, monetary value is inferred from actual past behaviour of individuals. Revealed preference techniques can in turn be divided into two sub-groups. The first is the household production function methods which infer monetary value from demand of complements or substitutes for the good or service whose value is being estimated. An example is the *Travel Cost Technique,* which uses the cost, in terms of monetary and travel time, incurred by a person in getting to, say, a national park as an estimate of the value of the national park to that person.

The second type of the revealed preference methods is the *Hedonic Price Technique* which is generally used to value location-related amenities. The basic premise of this technique is that the demand for a commodity is actually a demand for the characteristics embodied in the commodity (Lancaster; 1966, 1971). For example, a house is just a collection the

characteristics of the number of bedrooms, the number of bathrooms, the location in terms of noise, pollution, and nearness to the workplace. Thus according to Hedonic Price Technique, the price of a house is the sum of the price of the various characteristics embodied in the house. Consequently it is possible to decompose the price of the house (the market good) into the prices of the characteristics thus allowing us to estimate the price of, say, pollution.

2.2 Stated preference methods

Stated preference methods infer monetary value of a non-market good from intended behaviour, through a questionnaire survey. Contingent Valuation Method (CVM) falls under this category. It is often argued that respondents in a survey may not consider their answers carefully because there is no penalty for changing one's intentions. As a result, critics of the stated preference techniques argue that the quality of data obtained from these surveys is inferior to data observed under revealed preference methods (Bertrand & Mullithan, 2001). Despite these criticisms CVM has become an important analytical workhorse. Which of these methods is employed depends to a large extent on the nature of the study and the information required.

3. Undertaking contingent valuation

CVM attempts to estimate the value a person attaches to a non-market good or service by asking the person a simple question of the form:

- what is the maximum you would be willing to pay (WTP) to enjoy the benefits provided by the non-market commodity, or
- what is the minimum compensation you would be willing to accept (WTA) to endure the hardship of putting up with a problem.

The response to these questions would depend to a large extent on factors such as the person's income, prevailing prices and other social-economic characteristics of the respondent such as level of education and marital status. In theory, if the WTP is a small fraction of the individual's income, implying that there is no income effect, then WTP and WTA should be roughly equal. However studies have found that WTA is often larger than WTP for the same good. According to Haneman (1991) the divergence between WTP and the WTA is due, *inter alia*, to the view that people generally value losses more heavily than they value a gain.

3.1. Methods of elicitation of responses

A variety of methods are available for getting people to 'reveal' their WTP or WTA. Readers interested in a rigorous treatment should consult van Kooten & Bulte (2000).

The main methods are:

- open-ended question format
- iterative bidding format
- payment card approach
- dichotomous choice approach.

These methods are described briefly below.

- *Open ended question format*

Under the open ended format, respondents are asked a question such as "what is the maximum you are willing to pay for benefits from the non-market commodity A?" Or "what is the minimum you are willing to accept to forgo benefits from the non-A?" From the answers mean WTP can be obtained as follows:

$$Mean\ WTP = \frac{1}{N}\sum_{i}^{N} WTP_i \qquad (1)$$

Where N equals the sample size and WTP_i is the WTP of the i^{th} respondent. The mean WTP so obtained is multiplied by the relevant population to get to aggregate WTP. The main criticism of this approach is that respondents may give unrealistic responses motivated by strategic behaviour. Better questionnaire design can reduce the incidence of strategic behaviour.

- *Iterative bidding approach*

Under the iterative approach the interviewer nominates a value $X as the WTP and asks the respondent whether he or she would be willing to pay that amount for the benefits of the non-market commodity being valued. If the response is 'Yes' the amount $X is increased until the respondent would no longer be willing to pay. This amount is taken as that respondent's WTP. If, however, the answer is 'No' the $X is reduced until the respondent would be willing to pay. This amount is taken to be WTP of this respondent. The mean WTP of the sample is multiplied by the relevant population size to obtain the total WTP of the community. The iterative bidding approach is criticised because it is prone to starting point bias, a situation where the aggregate WTP is systematically related to the starting bid.

- *Payment card method*

Under this method a number of WTP values is written on a card and respondent is asked to select the value which is closest to his or her WTP. The amount nominated is interpreted as the WTP of the respondent. However, Cameron & Huppert (1989) have argued that the chosen amount

should be interpreted as the lower bound of respondent's WTP, with the upper bound being the next higher amount up on the card. Aggregate WTP is obtained in similar fashion to the iterative bidding format.

- *Dichotomous choice method*

Under the dichotomous choice approach, which is the most popular approach, respondents are randomly presented with differing $X amounts. Each respondent is asked only one question: whether he or she is prepared to pay $X to be able to enjoy the benefits of the non-market commodity. The response is either 'Yes' or 'No'. It is apparent that the dichotomous choice method does not provide WTP directly. The WTP is obtained by special statistical or econometric techniques. Because the $X amount facing each respondent is not varied, this approach is claimed to mimic what happens in real market situation where the consumer is quoted a price for a commodity, a price which the consumer accepts and purchases the commodity or rejects and does not buy the commodity. The view is only valid only to a certain extent in West African countries where bargaining between buyers and sellers is very common.

3.2 Steps in undertaking CVM

Figure 2 shows general stylized steps followed when undertaking a CV study. The first step involves a clear definition of the objectives of the valuation, the type of value, time span of the valuation and the relevant population from which to draw the sample. A national asset may require the whole population whereas for a localised asset the relevant population would be the people directed affected. The second step involves the design of questionnaire to use, a decision on the sampling technique to use, where, when and how to conduct the survey. This is followed by a decision on the information to collect and the type of elicitation format to use. The next stage involves data collation and checking to eliminate invalid responses. The last stage is to estimate the mean WTP of the sample and to use the sample mean WTP to estimate the WTP of the relevant population.

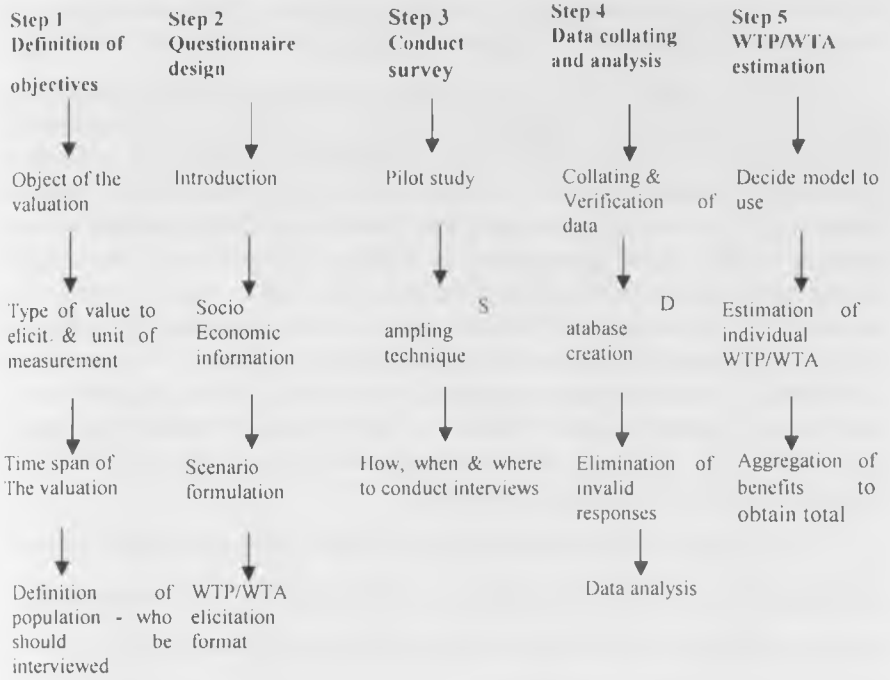

Figure 2: Organisation of CVM Survey
Source: adapted from http://chinaeol.net/wbi/eep/docs/presentations/Contingent%20Valuation%201.pdf

4. An illustrative example

This section provides an illustrative example of how to estimate WTP using the procedure described in Section 3.2. We shall assume that a Local Council would like to extend electricity to a village currently without electricity. The Local Council wants to undertake a cost-benefit analysis of extending electricity to this village. The council therefore needs an estimate of willingness to pay of the residents of the village for electricity (that is, the value that the residents attach to having electricity) to compare with the cost, to the Local Council, of connecting the village to the national electricity grid.

The steps described in Section 3.2 are self-explanatory hence details of each step will not be provided. The objective of the exercise is to estimate the WTP. Under 'Step 1' we have decided that the study should be conducted through a survey to be carried out in one day. In a small village setting conducting a survey such as this over many days could provide an

opportunity for respondents to be coached by village officials to provide a rehearsed response. Furthermore, since the WTP to be estimated concerns only the residents of the village, it can be treated as a strictly local issue, we draw a random sample of the respondents from only residents of the village.

Under 'Steps' 2 and 3, we design an appropriate questionnaire to be used in a face-to-face interview, mainly to collect socio-economic information on the respondents. See Taylor-Powell (1998) for a guide to questionnaire design. We have opted for a face-to-face survey because literacy level in the village is very low therefore self-administered or mail surveys would not be appropriate. In addition, since there is no reliable listing of residents in the village we have decided to survey every third house. The socio-economic information would show whether the estimated WTP is associated with particular socio-economic variables. This knowledge is helpful in situations where payment is to be based on say, income or any other socioeconomic status. Because of the estimation method we plan to use (Step 5) we decide to use the dichotomous choice approach to collect information on WTP of the respondents.

In 'Step 4' information collected from the survey is collated into a database using computer software such as Microsoft Excel. The resulting database (without the socio-economic variables) would look like the information in Tables 1A and 1B.

Table 1A: Result from hypothetical survey

Observation No.	Bid price ($ per year)	Accept/ Reject
1	100	1
2	300	1
3	700	0
4	900	0
5	900	0
6	100	0
7	100	1
8	700	0
9	700	0
10	500	0
11	700	0
12	900	0
13	700	1
14	900	0
15	300	0
16	100	1
17	100	1
18	900	0
19	900	0
20	500	0
21	300	1
22	500	0
23	500	1
24	300	1
25	500	1
26	700	0
27	500	1
28	100	1
29	300	0
30	300	1

Table 1B: Sorted result of survey data

Observation No.	Bid price ($ per year)	Accept/ Reject
1	100	1
6	100	0
7	100	1
16	100	1
17	100	1
28	100	1
2	300	1
15	300	0
21	300	1
24	300	1
29	300	0
30	300	1
10	500	0
20	500	0
22	500	0
23	500	1
25	500	1
27	500	1
3	700	0
8	700	0
9	700	0
11	700	0
13	700	1
26	700	0
4	900	0
5	900	0
12	900	0
14	900	0
18	900	0
19	900	0

Various analytical techniques are available for calculating the sample mean WTP (in Step 5) such as ordered response models from a class of discrete choice econometric models. See for example, Mohapi and Mankimane (2007) who used an ordered probit econometric model to estimate the demand for internet services in the halls of residence of the National University of Lesotho. However, a simple unsophisticated method exists that can be used. This is the method used to calculate WTP using data in Table 1A. To use this simpler procedure the following steps are to be followed:

1. Sort data in Table 1A in increasing order of proposed charge as done in Table 1B.
2. Calculate acceptance frequency for each proposed charge (Table 2).
3. Consider above frequencies as the cumulated frequencies of accept for each level of payment
4. Calculate the cumulated frequency of rejection
5. Calculate cumulated reject frequencies of max WTP for each bid price (column 1 of Table 3)
6. Calculate mean WTP

Calculation of 'Accept' and 'Reject' frequencies for each bid price is illustrated for first $100 as follows: Five out of the six people asked whether they would be willing to pay a $100 accepted to pay the $100 therefore the 'Accept' frequency for this price is 0.83 (5 divided by 6). The 'Reject" frequency for this price is 0.17 (one divided by six). Similar procedure is used to calculate 'Accept' and 'Reject' frequencies for each bid price. These are reported in Table 2.

Table 2: Accept and reject frequencies of each proposed charge

Bid price	Accept frequency	Reject frequency
100	0.83	0.17
300	0.67	0.33
500	0.50	0.50
700	0.17	0.83
900	0.0	1.0

Based on Table 1B

If the 'Reject' frequency for successive bid prices is assumed to be cumulative, the information in Table 2 can be transformed into the form presented in Table 3. Column 1 in Table 3 is simply a rearrangement of the 'Reject' frequency in Table 2.

Information in Table 3 is read as follows: In the first row of column 1, we know that 17% (0.17) rejected $100. From this we can infer that the WTP for this group is less than $100. This is recorded in column 2. It follows from Column 2 that the WTP for this group is between $0 and $100 as recorded in column 3. Column 4 records the simple average for this WTP range of zero and $100 as $50 [(0+100)/2]. Columns 1 and 2 of row 2 are similarly interpreted. However, column 3 makes use of the assumption that the 'Reject' frequencies are cumulative. As a result the 33 percent who reject the $300 is considered to be a cumulative frequency of the 17 percent reject that reject $100 and 16 percent (33% - 17%) who reject $300. This 16

percent have WTP between \$101 and \$300. A simple average of \$101 and \$300 is \$200 [(101+300)/2] as recorded in column 4. Similarly, the 50 percent 'Reject' frequency for \$500 is considered to be the cumulative is frequencies of 17 percent who reject \$100 plus the 16 percent who reject for \$300 plus 17 percent (50% - 17 % - 16%) that reject \$500. For this 17 percent we infer that their WTP lies between \$301 and \$500 given an average WTP for this range as \$400. This reasoning is used for the 83 percent rejection of \$700 and 100 percent rejection of \$900 to obtain the results reported in the last two rows.

Table 3: Cumulated reject frequencies for each bid

Cumulative frequency of rejection (1)	WTP upper bound (2)	Frequency for WTP class (3)	Assumption of class average[1] (4)
17% reject \$100	17% have WTP<\$100	17% 0≤ WTP<100	\$50
33% reject \$300	33% have WTP<\$300	16% 101≤ WTP<300	\$200
50% reject \$500	50% have WTP<\$500	17% 301≤ WTP<500	\$400
83% reject \$700	83% have WTP<\$700	33% 501≤ WTP<700	\$600
100% reject \$900	100% have WTP<\$900	17% 701≤ WTP<900	\$800

Notes:

1. These figures are the simple averages of the WTP class

Source: Based on information in Table 2

The mean WTP can be calculated from Table 3 by multiplying the frequencies for the WTP classes in column 3 by the corresponding average WTP in column 4 as shown below:

Mean WTP = (0.17 * \$50) + (0.16 * \$200) + (0.17 * \$400) + (0.33 * \$600) + (0.17 * \$800) = \$442.5

The weight mean WTP calculated above from the sample is then multiplied by the population of the village to obtain the total WTP of the village.

5. Some issues of CVM

CVM has been generally criticised on the basis of the validity of the responses obtained from the sample. We now discuss the main sources of problems in CVM.

- *Validity of responses*

The major problem with CVM is the hypothetical nature of the questions used to collect the data. Since people are being asked hypothetical questions in CVM surveys, the question arises whether the responses obtained would be the same as those that would have been obtained if markets existed. It can also be argued that the way the interview is conducted may influence the results. For example, the respondent may provide answers she thinks the interviewer expects - 'let's be nice to the interviewer syndrome'. Appropriate training of interviewers in interviewing techniques helps to reduce interviewer influence on the responses.

- *Strategic bias*

This bias occurs when the respondent behaves strategically by not giving his or her true valuation, but rather giving a valuation he or she hopes will achieve a particular outcome. For example, there is an incentive for a respondent to understate her true valuation in the hope of free riding if she believes that she would have to pay her reported WTP, and that her individual valuation will not influence whether the service is provided or not. On the other hand respondent has an incentive to overstate his true valuation in order to ensure the provision of the service if he belies that the provision of the service depends on the aggregate WTP, and if he does not actually have to pay his WTP. According to Boardman et al (2001, p 379) open-ended methods of eliciting WTP will generally be subject to upward bias (higher aggregate WTP) if payment is voluntary. The reverse bias (lower aggregate WTP) occurs if payment is coerced.

- *Starting point bias*

This bias arises if the initial valuation suggested by the interviewer in the bidding game is systematically related to the final bid reported by respondents. This bias can be reduced through pilot surveys to establish likely starting points.

- *Information bias*

The bias arises because respondents may not be familiar or knowledgeable about the scenario presented to them. For example, respondents may not be familiar with of complex issues such as extinction of species or preservation of bio-diversity in a tropical rain forest on which they are to provide

valuation. The provision of adequate information on the service or item being evaluated, and the context is essential to reduce this bias.

- *Payment vehicle bias*

Payment vehicle bias occurs when WTP depends on the choice of the method of payment. It is possible that a respondent who dislikes a particular type of payment will understate WTP if this method is the suggested method of payment. The existence and extent of this bias can be evaluated by using different payment methods to estimate WTP for the same scenario.

- *Additional problems in developing countries*

In addition to the general criticisms discussed above, CVM suffers from additional problems in developing countries which have to be taken into account to ensure the reliability of the information collected. First, because many developing countries do not have official listing of dwellings at the village level the sample used in CVM studies may not be random and thus responses may not be representative. Furthermore, the village may be so small that the whole community becomes aware of the study. This may lead to those sampled rehearsing their answers. Another problem commonly encountered in some villages in developing countries is that women, in the presence of their husband, tend to give answers acceptable to their husbands.

6. Conclusion comments

CVM has become an attractive tool for estimating the value of non-market goods and services, being used increasingly by international and donor agencies in assessing demand for sanitation and water services. Despite this increase in popularity, it must be remembered that the technique has been criticised, particularly in valuation situations where most of the value of the good being valued is of the 'non-use' type. In addition to the inherent bias of CVM, the application of the technique in developing countries is subject to further problems, as mentioned in Section 5.6. Improvements in survey design and pre-testing procedures are likely to minimise some of these shortcomings. For now, once these limitations are noted and steps are taken to minimise their impact a well conducted CVM can provide useful information for policy makers.

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